CLAIMS

What is claimed is:

1. A method for encoding a digital image by rate-distortion adaptive zerotree-based residual vector quantization comprising:

obtaining a digital image;

transforming said digital image into wavelet domain, thereby generating a pyramid hierarchy;

losslessly encoding a top low-low (LL) subband of said pyramid hierarchy, thereby obtaining a losslessly encoded portion of said digital image;

vector quantization (VQ) encoding all other subbands of said pyramid hierarchy, based on a zerotree insignificance prediction, thereby obtaining a lossy encoded portion of said digital image; and

outputting an encoded image from said losslessly encoded portion of said digital image and said lossy encoded portion of said digital image.

2. The method of claim 1, wherein said transforming said digital image into wavelet domain comprises a 2-dimensional separable octave decomposition which generates said pyramid hierarchy.

3. The method of claim 1, wherein said transforming comprises a Daubechies 9-7 symmetric wavelet transform.

4. The method of claim 1, wherein said transforming comprises a Two Six (TS) wavelet transform.

5. The method of claim 1, wherein said transforming comprises a Two Ten (TT) wavelet transform.

6. The method of claim 1, wherein said losslessly encoding a top LL subband comprises differential pulse coded modulator and Huffman coding.

7. The method of claim 1, wherein said losslessly encoding a top LL subband comprises differential pulse coded modulator and universal source coding.

8. The method of claim 1, wherein said losslessly encoding a top LL subband comprises differential pulse coded modulator and arithmetic coding.

9. The method of claim 1, wherein said VQ encoding comprises rate-distortion optimization along a threshtree.

10. The method of claim 1, wherein said VQ encoding includes targeted rate control.

11. A method for decoding an image encoded by rate-distortion adaptive zerotree-based residual vector quantization, comprising:

obtaining said encoded image;

reconstructing a zerotree from said encoded image;

vector quantization decoding subbands in said encoded image other than a top LL subband;

losslessly decoding said top LL subband;

reverse wavelet transforming said top LL subband and said vector quantization decoded subbands; and

outputting a decoded image from said decoded top LL subband and said decoded subbands other than said decoded top LL subband.

12. A method for transmitting a digital image across a communications channel comprising:

obtaining a digital image;

transforming said digital image into wavelet domain, thereby generating a pyramid hierarchy;

losslessly encoding a top low-low (LL) subband of said pyramid hierarchy, thereby obtaining a losslessly encoded portion of said digital image;

vector quantization (VQ) encoding all other subbands of said pyramid hierarchy, based on a zerotree insignificance prediction, thereby obtaining a lossy encoded portion of said digital image;

outputting an encoded image from said losslessly encoded portion of said digital image and said lossy encoded portion of said digital image;

transmitting said encoded image along a communications channel;

obtaining said encoded image transmitted along said communications channel;

reconstructing a zerotree from said encoded image;

vector quantization decoding subbands in said encoded image other than a top LL subband;

losslessly decoding said top LL subband;

reverse wavelet transforming said top LL subband and said vector quantization decoded subbands; and

outputting a decoded image from said decoded top LL subband and said decoded subbands other than said decoded top LL subband.

13. The method of claim 12, wherein said transforming comprises a wavelet transform selected from the group comprising a Daubechies 9-7 symmetric wavelet transform, a Two Six (TS) wavelet transform and a Two Ten (TT) wavelet transform.

14. The method of claim 12, wherein said losslessly encoding a top LL subband comprises differential pulse coded modulator (DPCM) and Huffman coding.

15. The method of claim 12, wherein said losslessly encoding a top LL subband comprises Universal source coding.

16. An integrated circuit for implementing a method for encoding a digital image by rate-distortion adaptive zerotree-based residual vector quantization, said method comprising:

obtaining a digital image;

transforming said digital image into wavelet domain, thereby generating a pyramid hierarchy;

losslessly encoding a top low-low (LL) subband of said pyramid hierarchy, thereby obtaining a losslessly encoded portion of said digital image;

vector quantization (VQ) encoding all other subbands of said pyramid hierarchy, based on a zerotree insignificance prediction, thereby obtaining a lossy encoded portion of said digital image; and

outputting an encoded image from said losslessly encoded portion of said digital image and said lossy encoded portion of said digital image.

17. The integrated circuit of claim 16, wherein said transforming comprises a wavelet transform selected from the group comprising a Daubechies 9-7 symmetric wavelet transform, a Two Six (TS) wavelet transform and a Two Ten (TS) wavelet transform.

18. An integrated circuit for implementing a method for decoding a digital image that has been encoded by rate-distortion adaptive zerotree-based residual vector quantization, said method comprising:

obtaining said encoded image;

reconstructing a zerotree from said encoded image;

vector quantization decoding subbands in said encoded image other than a top LL subband;

losslessly decoding said top LL subband;

reverse wavelet transforming said top LL subband and said vector quantization decoded subbands; and

outputting a decoded image from said decoded top LL subband and said decoded subbands other than said decoded top LL subband.

19. An integrated circuit for coding and decoding an image by rate-distortion adaptive zerotree-based residual vector quantization.

20. The integrated circuit of claim 19, wherein said coding comprises:

transforming said digital image into wavelet domain, thereby generating a pyramid hierarchy;

losslessly encoding a top low-low (LL) subband of said pyramid hierarchy, thereby obtaining a losslessly encoded portion of said digital image;

vector quantization (VQ) encoding all other subbands of said pyramid hierarchy, based on a zerotree insignificance prediction, thereby obtaining a lossy encoded portion of said digital image; and

outputting an encoded image from said losslessly encoded portion of said digital image and said lossy encoded portion of said digital image.

21. The integrated circuit of claim 19, wherein said decoding comprises:

reconstructing a zerotree from an encoded image;

reconstructing a zerotree from said encoded image;

vector quantization decoding subbands in said encoded image other than a top LL subband;

losslessly decoding said top LL subband;

reverse wavelet transforming said top LL subband and said vector quantization decoded subbands; and

outputting a decoded image from said decoded top LL subband and said decoded subbands other than said decoded top LL subband.

22. A circuit card for implementing a method for encoding and decoding an image using rate-distortion adaptive zerotree-based residual vector quantization.

23. The circuit card of claim 22, wherein said circuit card comprises circuitry configured for:

obtaining a digital image;

transforming said digital image into wavelet domain, thereby generating a pyramid hierarchy;

losslessly encoding a top low-low (LL) subband of said pyramid hierarchy, thereby obtaining a losslessly encoded portion of said digital image;

vector quantization (VQ) encoding all other subbands of said pyramid hierarchy, based on a zerotree insignificance prediction, thereby obtaining a lossy encoded portion of said digital image; and

outputting an encoded image from said losslessly encoded portion of said digital image and said lossy encoded portion of said digital image.

24. The circuit card of claim 23, wherein said circuit card further comprises circuitry configured for:

obtaining said encoded image;

reconstructing a zerotree from said encoded image;

vector quantization decoding subbands in said encoded image other than a top LL subband;

losslessly decoding said top LL subband;

reverse wavelet transforming said top LL subband and said vector quantization decoded subbands; and

outputting a decoded image from said decoded top LL subband and said decoded subbands other than said decoded top LL subband.

25. A system for transmitting an image over a communications channel, wherein said system implements a method for encoding, transmitting and decoding a digital image by rate-distortion adaptive zerotree-based residual vector quantization, said method comprising:

obtaining a digital image;

transforming said digital image into wavelet domain, thereby generating a pyramid hierarchy;

losslessly encoding a top low-low (LL) subband of said pyramid hierarchy, thereby obtaining a losslessly encoded portion of said digital image;

vector quantization (VQ) encoding all other subbands of said pyramid hierarchy, based on a zerotree insignificance prediction, thereby obtaining a lossy encoded portion of said digital image;

outputting an encoded image from said losslessly encoded portion of said digital image and said lossy encoded portion of said digital image;

transmitting said encoded image along a communications channel;

obtaining said encoded image transmitted along said communications channel;

reconstructing a zerotree from said encoded image;

vector quantization decoding subbands in said encoded image other than a top LL subband;

losslessly decoding said top LL subband;

reverse wavelet transforming said top LL subband and said vector quantization decoded subbands; and

outputting a decoded image from said decoded top LL subband and said decoded subbands other than said decoded top LL subband.